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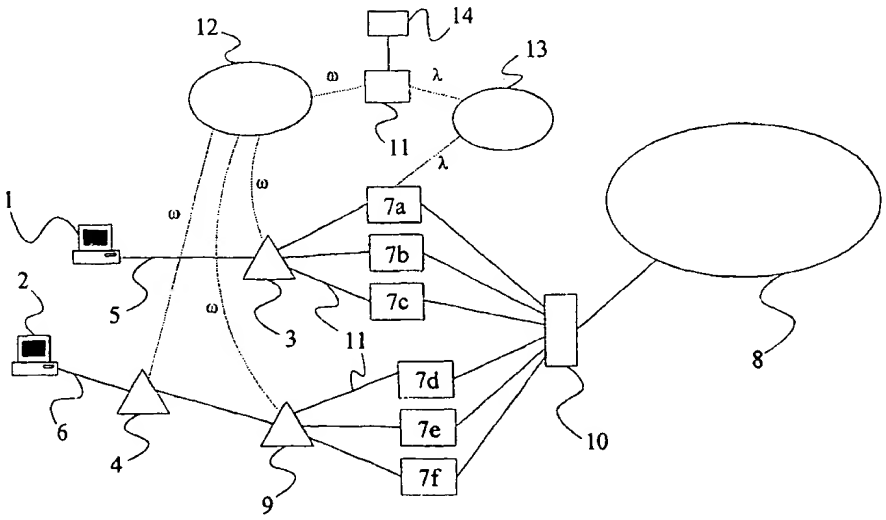

(57) Abstract

A method of signalling in a telecommunications network to control a set of circuit switched channels between a network exchange (3, 9) and an Internet Access Server (NAS, 7). Signalling data is transmitted between the exchange (3, 9) and a gateway node (11) using SS7 protocol, the exchange (3, 9) and the gateway node (11) being assigned respective SS7 Point Codes. The signalling data is then transmitted between the IAS (7) and the gateway node (11) using Internet Protocol (IP), the gateway node (11) and the IAS (7) being assigned respective IP addresses. The gateway node (11) is provided with a look-up table mapping the IAS IP address to the exchange Point Code and a set of identifiers corresponding to said set of channels. Signalling data received at the gateway node (11) from the exchange (3, 9) is routed to the IAS (7) using the IP address for the IAS (7) obtained from the look-up table using the Point Code of the source exchange (3, 9) and a channel identifier conveyed with the signalling data.

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Network Access Server Control

Field of the Invention

The present invention relates to the control of data network access servers and in particular, though not necessarily, to the control of network access servers connecting subscribers of a telecommunications network to a data network.

Background to the Invention

Access to the Internet, and in particular to the World Wide Web (WWW), is usually obtained via a telecommunication network to which a user subscribes, the user interface being a Personal Computer (PC) or the like. The telecommunication network provides the user with a reserved telephone line (or rather channel) to a Network Access Server (NAS) operated by an Internet Service Provider (ISP), and a so-called Point-to-Point Protocol (PPP) connection is established between the user and the NAS. The NAS provides the user with an Internet Protocol (IP) address and acts as a protocol converter between the circuit switched transmission protocol of the telecommunications network (typically E.1 or T.1) and the packet switched Internet Protocol (usually TCP/IP).

There are now also available so-called Internet Access Servers (IAS) which enable the operator of a telecommunications network to connect its subscribers directly to the WWW without the need for an external ISP. Typically, several IAS are connected to an exchange of the telecommunications network and provide functionality similar to that provided by conventional NAS. The advantage of the IAS approach is that

subscribers may be charged for telephone connections and WWW access in a single bill issued by the telecommunications network. It follows that a subscriber may be billed relatively small amounts for WWW access, which could otherwise not be billed in an economical manner.

In the case of the E.1 or T.1 telecommunications network transmission protocol, a signalling protocol known as Signalling System 7 is commonly used to establish, maintain, and terminate circuit switched channels between various components of a telecommunications network. In particular, SS7 is used to control the channel between the local exchange of a subscriber, any intermediate or transit exchanges, and an IAS allocated to the subscriber. SS7 occupies one time slot per frame of the Time Division Multiple Access (TDMA) E.1 or T.1 transmission protocols (the other slots being available for user data).

SS7 makes use of addresses known as Point Codes to route signalling data through the "visibility area" of a telecommunications network, the visibility area typically being the network itself together with the interfaces between the network and "foreign" networks under the control of other operators. A Point Code is placed in the header of a signalling packet and is examined by an exchange upon receipt of the packet to determine the next hop for the packet en route to its destination.

SS7 provides for a 12 bit Point Code, i.e. 4096 possible unique addresses. This has been sufficient for conventional networks having a relatively small number of exchanges. However, with the introduction of IASs, each of which requires its own Point Code within a

network's visibility area, it is likely that 4096 Point Codes will be insufficient.

Summary of the Present Invention

It is an object of the present invention to provide a communications network in which the above noted disadvantage is overcome or at least mitigated.

It is a second object of the invention to provide a communications network comprising data network access servers and in which each access server does not necessarily require its own signalling address within the communications network.

According to a first aspect of the present invention there is provided a method of signalling in a telecommunications network to control a set of circuit switched channels between a network exchange and a data network access server (NAS), the method comprising:

transmitting signalling data between the exchange and a gateway node using a circuit switched transmission protocol, the exchange and the gateway node being assigned respective Point Code addresses under said circuit switched transmission protocol;

transmitting signalling data between the data NAS and the gateway node using a packet switched transmission protocol, the gateway node and the NAS being assigned respective addresses under said packed switched transmission protocol;

providing a look-up table at the gateway node mapping the NAS packet switched transmission protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels; and

receiving signalling data at the gateway node from the exchange, and routing the data to the NAS using the packet switched transmission protocol address for the

NAS obtained from said look-up table using the Point Code address of the source exchange and a channel identifier conveyed with the signalling data.

Embodiments of the present invention have the advantage that signalling data is routed to a data network access server using a data network address rather than a telecommunications network signalling protocol address. Thus the number of network access servers which can be used within the visibility area of the telecommunications network is significantly increased. Furthermore, it is possible to share a data network interface of the network access server for both signalling purposes and for accessing the data network itself, i.e. there is no need to provide a separate, dedicated signalling interface at the network access server.

It is envisaged that the main application of the present invention will be the connection of subscriber terminals to the Internet (and more particularly to make use of the World Wide Web (WWW)), where said packet switched signalling protocol is Internet Protocol (IP), and said data network addresses assigned to the gateway node and to the data network access server are IP addresses. Signalling data may be transmitted between the gateway node and the network access server via the WWW or via a closed connection such as a data bus connecting the exchange to the network access server.

It is also envisaged that the invention may be used to provide connections to data networks other than the WWW, for example Local Area Networks (LANs) and Wide Area Networks (WANs) in which the Signalling protocol may be IP or some other protocol.

In a preferred embodiment of the present invention, the circuit switched signalling protocol of the telecommunications network is Signalling System 7 (SS7).

Preferably, said gateway node is coupled to a plurality of exchanges, each exchange being coupled in turn to a set of NASs. Said look-up table then contains a list of the NAS packet switched transmission protocol addresses and, for each such address, the Point Code address of the associated exchange and the channel identifiers of the channels between the NAS and the exchange.

According to a second aspect of the present invention there is provided apparatus for controlling a set of circuit switched channels between a network exchange and a data network access server (NAS), the apparatus comprising:

a gateway node coupled between the NAS and the exchange;

first transmitting means for transmitting signalling data between the exchange and the gateway node using a circuit switched transmission protocol, the exchange and the gateway node being assigned respective Point Code addresses under said circuit switched transmission protocol;

second transmitting means for transmitting signalling data between the data NAS and the gateway node using a packet switched transmission protocol, the gateway node and the NAS being assigned respective addresses under said packed switched transmission protocol; and

data storage means at or coupled to the gateway node and providing a look-up table mapping the NAS packet switched transmission protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels,

wherein the gateway node is arranged in use to receive signalling data from the exchange, and to route the data to the NAS using the packet switched transmission protocol address for the NAS obtained from said look-up table using the Point Code address of the source exchange and a channel identifier conveyed with the signalling data.

According to a third aspect of the present invention there is provided a gateway node of a telecommunications network, the gateway node being arranged to route signalling data to control a set of circuit switched channels between a network exchange and a data network access server (NAS), the gateway node comprising:

first input/output means for communicating signalling data between the gateway node and the exchange using a circuit switched transmission protocol, the exchange and the gateway node being assigned respective Point Code addresses under said circuit switched transmission protocol;

second input/output means for transmitting signalling data between the gateway node and the NAS using a packet switched transmission protocol, the gateway node and the NAS being assigned respective addresses under said packed switched transmission protocol;

data storage means providing a look-up table mapping the NAS packet switched transmission protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels; and

routing means for routing signalling data received from the exchange to the NAS using the packet switched transmission protocol address for the NAS obtained from said look-up table using the Point Code address of the source exchange and a channel identifier conveyed with the signalling data.

Brief Description of the Drawings

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows schematically a telecommunications network including signalling connections;

Figure 2 is a flow diagram illustrating the method of operation of the network of Figure 1; and

Figure 3 illustrates a modification to the network of Figure 1.

Detailed Description of Certain Embodiments

As has already been described above, a subscriber terminal may be connected to the World Wide Web (WWW) via a telecommunications network having an Internet Access Server (IAS). In Figure 1 there is shown a pair of subscriber terminals 1,2 connected to respective local exchanges 3,4 via Integrated Services Digital Network (ISDN) lines 5,6. Connections are facilitated by modems internal to the subscriber terminals 1,2. The ISDN lines 5,6 may also connect to intermediate concentrators, i.e. multiplexers/demultiplexers, although these are not shown in Figure 1.

In certain cases, the local exchange of a subscriber terminal may be provided with a set of Internet Access Servers (IAS) 7a to 7c through which the subscriber terminal may access the WWW 8. This is the case for the local exchange 3 of the subscriber terminal 1. In other cases, as illustrated for the subscriber terminal 2, the local exchange 4 routes a connection to a second exchange 9 at which the necessary IASs 7d to 7f are provided. It will be appreciated that a connection may

be made via one or more additional, transit exchanges. The IASs 7 are coupled to the WWW 8 via one or more routers 10 which provide multiplexing/demultiplexing between the IASs 7 and the high capacity WWW lines.

When a WWW access request is made by a subscriber terminal 1,2, e.g. by dialing a predefined access telephone number from the subscriber terminal and which is recognized by an "intelligent network" associated with one of the exchanges, a circuit switched connection must be established between the subscriber terminal 1,2 and an IAS 7 of the "terminating" exchange 3,9. This circuit switched channel is carried by the corresponding ISDN line 5,6 and by a line 11 connecting the exchange 3,9 to the IAS 7. Typically, there are in the region of 300 64Kbit/sec channels available between an exchange and one of the associated IASs 7. These channels are provided in Europe according to the E.1 transmission protocol and in America according to the T.1 transmission protocol. In either case, each of the channels has a channel identifier known as a Circuit Identification Code (CIC) which is unique to the associated exchange. For example, with reference to the exchange 3 in Figure 1, channel identifiers 0-299 may be allocated to IAS 7a, 300-599 to IAS 7b, and 600-899 to IAS 7c. The same sets of identifiers may be allocated to IASs 7d to 7f for the exchange 9.

The setting-up of a circuit switched channel to a subscriber terminal 1,2 is achieved using a gateway node 11 which provides an interface between the exchanges 3,9 and the IASs 7. More particularly, signalling messages are conveyed between the exchanges and the gateway node according to the Signalling System 7 (SS7) protocol which is defined in ITU standard series Q.700 and which is carried on top of the E.1/T.1 transmission protocol

(in Figure 1 signalling messages are illustrated using broken lines whilst the flow of user data is illustrated with solid lines). The exchanges 3,9 (and 4) and the gateway node 11 are allocated Point Code addresses in the SS7 network. Signalling data transmitted over the telecommunications network accompanied by the Point Code of the intended destination and the Point Code of the data source. The SS7 signalling is identified in Figure 1 by the reference numeral 12 whilst SS7 messages are identified by the symbol ω. It will be appreciated that the function of the signalling system 12 (including transmitting and receiving SS7 messages) is distributed over the network, including the exchanges 3,9 and the gateway node 11.

Each of the IASs 7 is allocated an Internet Protocol (IP) address. The gateway node 11 is also allocated an IP address to enable signalling data to be transmitted between the gateway node 11 and the IASs 7 using a packet switched data transmission protocol such as TCP/IP, indicated in Figure 1 by the numeral 13 (again, the functionality of the feature 13, i.e. transmitting and receiving IP/TCP messages, is distributed across the network, including the NASs and the gateway node 11). These IP transmissions (identified in Figure 1 by the symbol λ) are carried via dedicated lines connecting the gateway node 11 and the IASs, although only one such line is shown in Figure 1. The gateway node 11 acts as an interface between the SS7 data on the exchange side of the interface and the packet switched transmission protocol on the IAS side.

The gateway node 11 has an associated memory 14 in which is stored a look-up table. This table contains a list of IP addresses allocated to the network's IASs 7. The table also contains, for each IP address, the Point Code

of the exchange 3,8 to which the corresponding IAS is connected together with the range of circuit switched channel identifiers provided between that IAS and the exchange. The look-up table may therefore have the following format, where exchange 3 in Figure 1 has the Point Code (PC) 1, exchange 9 has the Point Code 2, (NB. column 4 is included only for the sake of reference to Figure 1):

IP address	Channel ID range	Source exchange PC	Figure 1 IAS reference numeral
123.456	0-299	1	7a
123.457	300-599	1	7b
123.458	600-899	1	7c
123.459	0-299	2	7d
123.460	300-599	2	7e
123.461	600-899	2	7f

The information held in the look-up table may be fixed, or may be updated dynamically.

Upon receipt of a WWW access request from a subscriber terminal 1,2, a controller of the terminating exchange 3,9 allocates to the terminal 1,2 a circuit switched channel to one of the associated IASs 7. The allocated IAS 7 is notified of the allocation by first sending an SS7 signalling message ω from the exchange 3,9 to the gateway node 11. Included in this message are the Point Code of the gateway node (by means of which the message is routed to the gateway node), the Point Code (1 or 2) of the source exchange 3,9, and the channel identifier (0-899) of the allocated channel. On the basis of the latter two pieces of information, the gateway node 11 is able to determine, from its look-up table 14, the IP address of the allocated IAS 7. The signalling message is then converted into the TCP format λ and is

transmitted over the IP network 13 to the IAS 7 on the basis of the determined IP address.

It will already be apparent that each of the IAS 7 requires an IP interface in order to communicate with the router 10 and the WWW 8. This interface is also used to communicate with the IP network 13 and the gateway node 11. Thus, the IASs 7 require no additional SS7 interface in order to receive signalling data from the telecommunications network. Furthermore, as signalling data is routed to the IASs 7 on the basis of an IP address, there is no need to allocate to each IAS an own Point Code.

There is shown in Figure 2 a flow chart containing the main steps (100 to 106) in the operation of the network of Figure 1 *vis-à-vis* network signalling.

In the embodiment described above, the IP network 13 via which network signalling data λ is carried is isolated from the WWW 8. However, providing that security is not an issue, or can be ensured (e.g. by encryption), the signalling data λ may be routed via the WWW 8. This is illustrated in Figure 3 where features corresponding to those of Figure 1 are identified by like reference numerals.

It will be appreciated by the person of skill in the art that various modifications may be made to the above described embodiments without departing from the scope of the present invention. For example, the functionality of the gateway node may be integrated into some other component of the system, for example an exchange of the system.

Claims

1. A method of signalling in a telecommunications network to control a set of circuit switched channels between a network exchange and a data network access server (NAS), the method being **characterized** in:

transmitting signalling data between the exchange and a gateway node using a circuit switched transmission protocol, the exchange and the gateway node being assigned respective Point Code addresses under said circuit switched protocol;

transmitting signalling data between the data NAS and the gateway node using a packet switched transmission protocol, the gateway node and the NAS being assigned respective addresses under said packed switched protocol;

providing a look-up table at the gateway node mapping the NAS packet switched protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels; and

receiving signalling data at the gateway node from the exchange, and routing the data to the NAS using the packet switched protocol address for the NAS obtained from said look-up table using the Point Code address of the source exchange and a channel identifier conveyed with the signalling data.

2. A method according to claim 1 used to connect subscriber terminals to the Internet, where said packet switched transmission protocol is Internet Protocol (TCP/IP), and said data network addresses assigned to the gateway node and to the data network access server are IP addresses.

3. A method according to claim 1 or 2, wherein signalling data is transmitted between the gateway node and the network access server via the Internet.

4. A method according to claim 1 or 2, wherein signalling data is transmitted between the gateway node and the network access server via a closed connection comprising a data bus connecting the exchange to the network access server.

5. A method according to any one of the preceding claims, wherein the signalling data is formatted for transmission by said circuit switched transmission protocol according to Signalling System 7 (SS7) protocol.

6. A method according to any one of the preceding claims, wherein said gateway node is coupled to a plurality of exchanges, each exchange being coupled in turn to a set of NASs, and said look-up table contains a list of the NAS packet switched protocol addresses and, for each such address, the Point Code address of the associated exchange and the channel identifiers of the channels between the NAS and the exchange.

7. Apparatus for controlling a set of circuit switched channels between a network exchange (3,9) and a data network access server (NAS,7)), the apparatus being **characterized** in:

a gateway node (11) coupled between the NAS (7) and the exchange (3,9);

first transmitting means (12) for transmitting signalling data between the exchange (3,9) and the gateway node (11) using a circuit switched transmission protocol, the exchange (3,9) and the gateway node (11)

being assigned respective Point Code addresses under said circuit switched protocol;

second transmitting means (13,8) for transmitting signalling data between the data NAS (7) and the gateway node (11) using a packet switched transmission protocol, the gateway node (11) and the NAS (7) being assigned respective addresses under said packed switched protocol; and

data storage means (14) at or coupled to the gateway node (11) and providing a look-up table mapping the NAS packet switched protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels,

wherein the gateway node (11) is arranged in use to receive signalling data from the exchange (3,9), and to route the data to the NAS (7) using the packet switched protocol address for the NAS (7) obtained from said look-up table using the Point Code address of the source exchange (3,9) and a channel identifier conveyed with the signalling data.

8. A gateway node of a telecommunications network, the gateway node (11) being arranged to route signalling data to control a set of circuit switched channels between a network exchange (3,9) and a data network access server (NAS,7), the gateway node (11) being **characterized** in:

first input/output means (12) for communicating signalling data between the gateway node (14) and the exchange (3,9) using a circuit switched transmission protocol, the exchange (3,9) and the gateway node (11) being assigned respective Point Code addresses under said circuit switched protocol;

second input/output means (13,8) for transmitting signalling data between the gateway node (11) and the NAS (7) using a packet switched transmission protocol,

the gateway node (11) and the NAS (7) being assigned respective addresses under said packed switched protocol;

data storage means (14) providing a look-up table mapping the NAS packet switched protocol address to the exchange Point Code address and a set of identifiers corresponding to said set of channels; and

routing means (13,8) for routing signalling data received from the exchange (3,9) to the NAS (7) using the packet switched protocol address for the NAS (7) obtained from said look-up table (14) using the Point Code address of the source exchange (3,9) and a channel identifier conveyed with the signalling data.

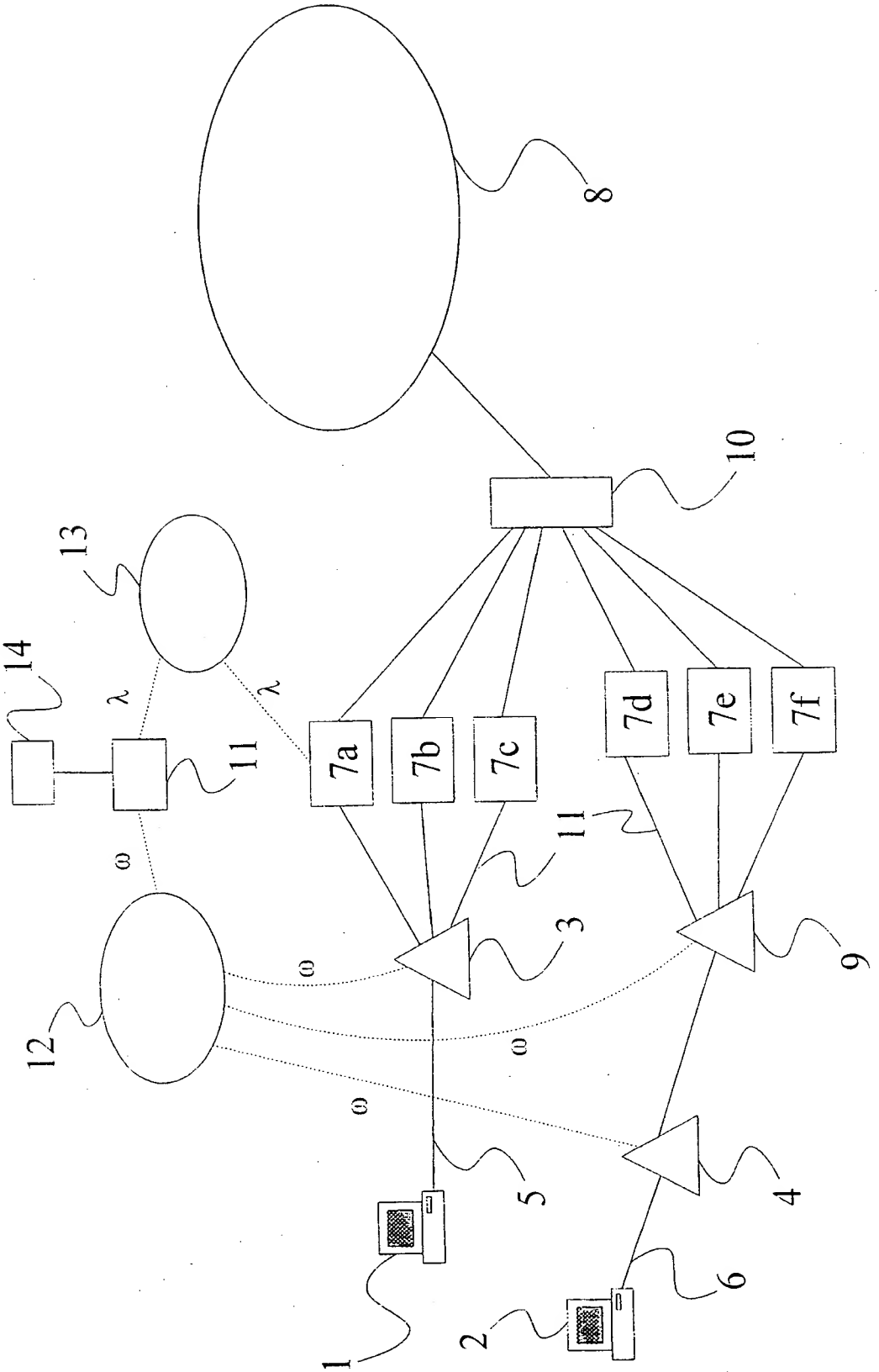

Fig. 1

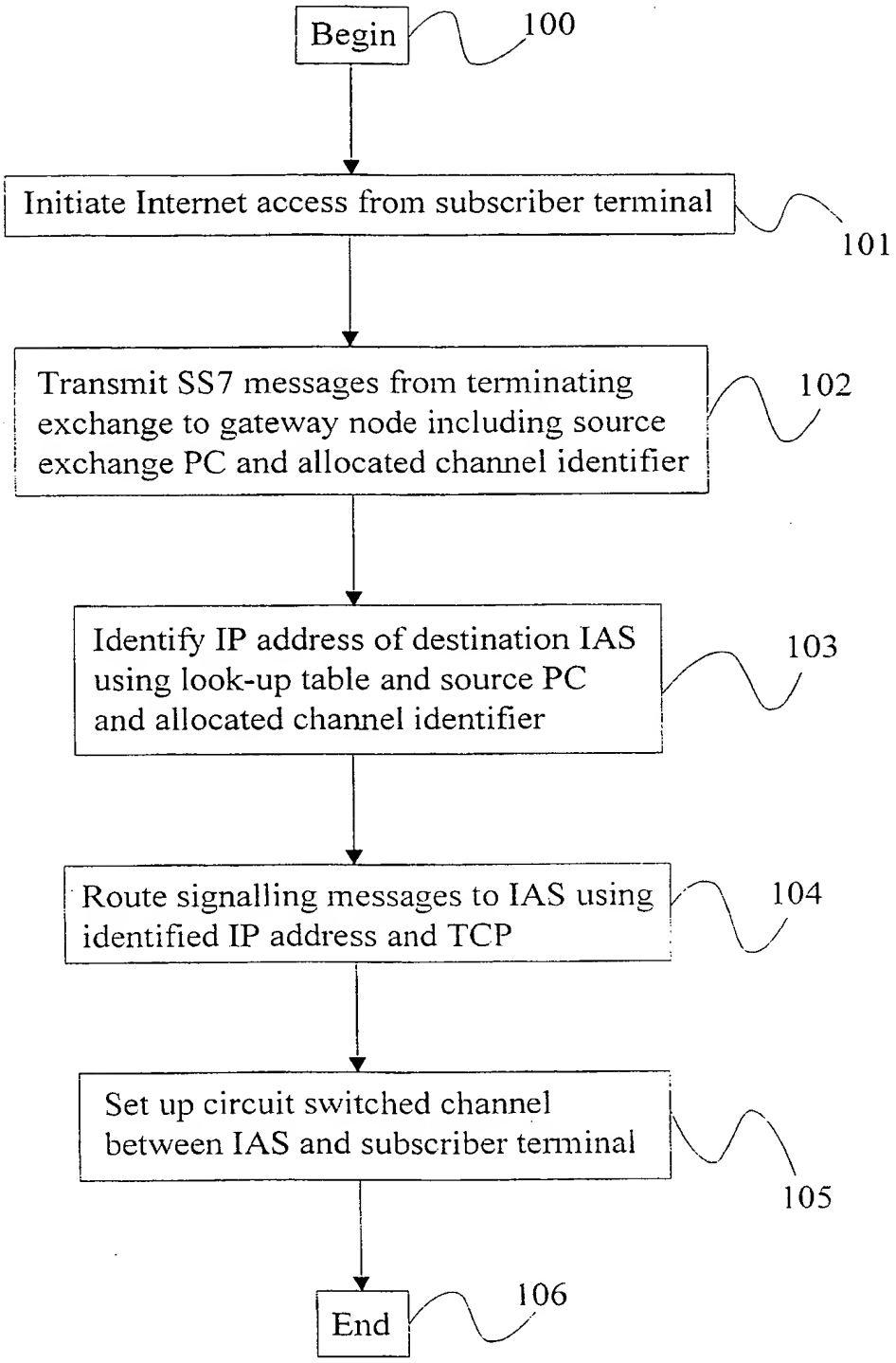

Fig. 2

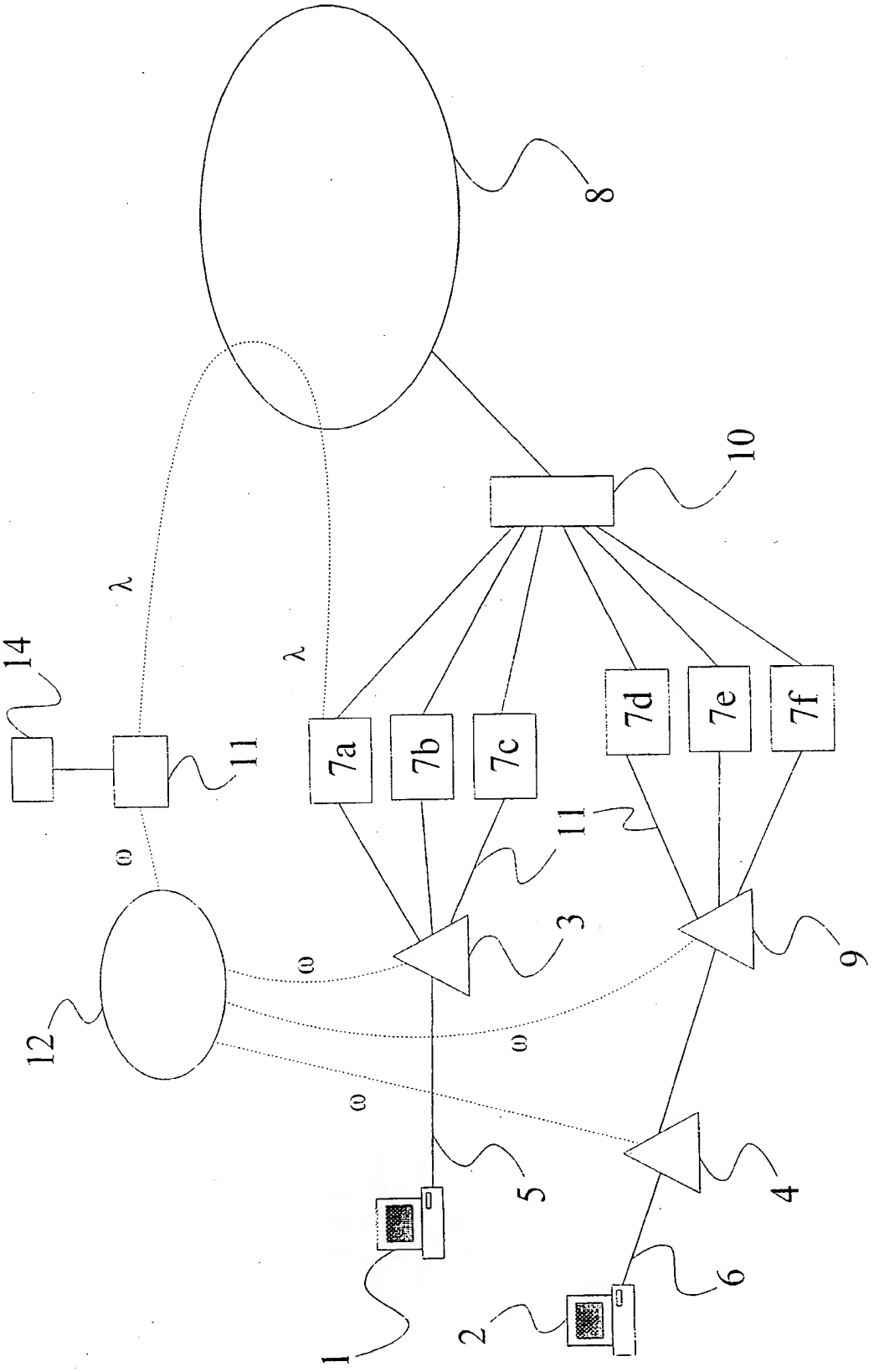

Fig. 3

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/EP 99/04137

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L12/66 H04Q3/00 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 September 1999	04/10/1999

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter ional Application No
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